

# Unit 5

## Plants: Anatomy, Growth, and Function

### OVERALL EXPECTATIONS

- evaluate the importance of sustainable use of plants to Canadian society and other cultures
- investigate the structures and functions of plant tissues, and factors affecting plant growth
- demonstrate an understanding of the diversity of vascular plants, including their structures, internal transport systems, and role in maintaining biodiversity

### BIG IDEAS

- Plants have specialized structures with distinct functions that enable them to respond and adapt to their environment.
- Plant variety is critical to the sustainability of ecosystems.

### UNIT TASK PREVIEW

As you progress through this unit, you will read about the importance of plants to society and to human populations. You will also explore how humans use plants as a resource. For the Unit Task, you will choose one plant that has made a significant impact on human society and research how it is grown and used. You will also discuss how we might grow and use this plant in a more sustainable way.

The Unit Task is described in detail on page 630. As you work through the unit look for Unit Task Bookmarks to see how information in the section relates to the Unit Task.



### WAKING UP TO COFFEE

Many of us start our day with a cup of coffee. Coffee is the second most valuable traded commodity on Earth, next to petroleum. Coffee helps the world get to work in more than one way!

Coffee “beans” are not really beans. Rather, they are the seeds found in the berries of the coffee plant; the berries turn red as they ripen. Coffee berries are harvested from two coffee plant species, both native to Africa. Coffee plants are evergreen shrubs or small trees that grow in shaded areas. Traditionally, coffee producers have planted coffee plants among the other trees of the rainforest, which, in turn, provide shade for the coffee plants. The demand for coffee has grown, and coffee is now cultivated in over 70 tropical and subtropical countries, including many Central and South American countries.

The high demand has changed the way coffee is grown. For efficiency, land was cleared and coffee plants were grown in full sunshine on plantations. Clearing the land negatively affected plant and animal species that relied on the natural forest, including some songbirds that migrate from North America. These include orioles, warblers, thrushes, and vireos. These birds spend the winter in Central and South America. Clearing the land for coffee plantations reduces their winter habitat.

Coffee plantations have other ecological consequences. The plantations are monocultures, so they lack diversity and are more susceptible to disease and pests than the natural rainforest is. Growers therefore use insecticides, fungicides, and herbicides. Plantations must also be irrigated, since there is no shade to reduce evaporation of water from the soil. Since agricultural chemicals and irrigation can damage the natural environment, coffee plantations are not environmentally sustainable.

As consumers learned more about the environmental damage coffee production has caused, methods of coffee production slowly began to change. You may have seen “organic shade-grown” labels on coffee packages in your local coffee shop. Organic shade-grown coffee is grown on smaller farms and farm co-operatives without the use of chemical fertilizers. Either existing rainforest trees shade the coffee plants, or fast-growing shade trees are planted. This helps prevent soil erosion and water pollution and maintains habitat for songbirds. Interestingly, most people think shade-grown coffee tastes better than plantation-grown coffee. However, there is a downside. Producing coffee this way is much more labour intensive and the yields are lower, so shade-grown coffee costs considerably more than plantation-grown coffee. As with many issues involving sustainability and the environment, economics always plays a role. As individual consumers, we have to decide how to balance price with environmental concerns.

#### Questions

1. Coffee drinking is also associated with long lineups at drive-throughs and with disposable cups. How do these factors influence the environmental impacts of coffee consumption?
2. Should all coffee shops be made to offer organic shade-grown coffee? Explain your rationale.
3. Create a graphic organizer with the word “sustainability” at the centre. Fill in the graphic organizer using the information about coffee production above.



## CONCEPTS

- describe the process of cell division and specialization
- recognize the organization of cells into tissues, organs, and systems
- explain basic plant cell structure
- understand the relationship between photosynthesis and cellular respiration
- recognize the factors that influence ecosystem sustainability, including the activities of humans

## SKILLS

- prepare a wet-mount
- use a microscope properly
- draw labelled biological diagrams
- communicate ideas, plans, procedures, results, and conclusions using appropriate language and formats
- analyze and interpret qualitative and/or quantitative data

## Concepts Review

- Match each term on the left with the most appropriate description on the right. **K/U**

(a) vascular tissue	(i) rigid outermost cell layer found in plants and certain algae, bacteria, and fungi
(b) xylem	(ii) movement of molecules from an area of higher concentration to an area of lower concentration
(c) osmosis	(iii) tissue that carries water and dissolved substances up from the roots
(d) phloem	(iv) movement of water molecules across a selectively permeable membrane
(e) chlorophyll	(v) tissue that transports sugars and other dissolved substances throughout the plant and down to the roots
(f) vacuole	(vi) conductive tissue that transports water and dissolved substances
(g) cell wall	(vii) pigment that captures energy from sunlight for photosynthesis
(h) diffusion	(viii) large, fluid-filled compartment in plant cell
- Describe the location and role of stomata in plants. **K/U**
- Photosynthesis and cellular respiration have been called complementary processes. **K/U T/I A**
  - Write the word equation for photosynthesis and the word equation for cellular respiration.
  - Explain why photosynthesis and cellular respiration are said to be complementary processes.
  - Based on your answer for (a), predict what would happen if there was less photosynthesis globally.

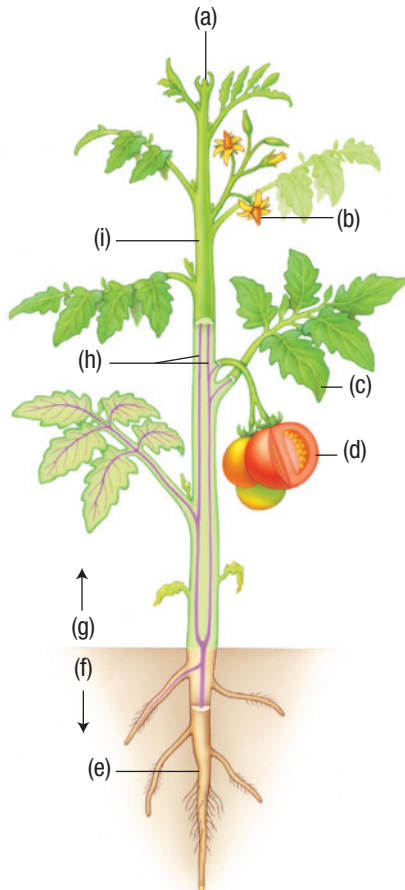
- Compare the two images in **Figure 1**. Based on what you see in the photographs, predict which farm has more biodiversity.
  - Which of the two farms in Figure 1 is more sustainable? Explain why. **T/I A**



Figure 1

- What is the function of meristematic tissue?
  - What other process is needed for a cell to become specialized (e.g., to become an epidermal cell)? **K/U**
- Do plants have organs and organ systems? Explain your reasoning. **K/U**

7. Identify the structures shown in **Figure 2**. K/U



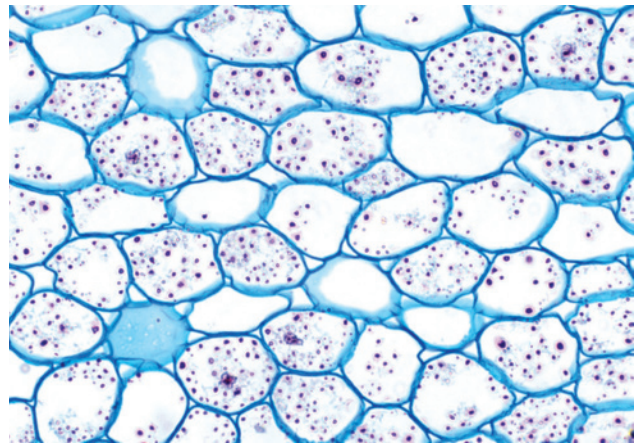
**Figure 2** Basic plant body

8. In what cell organelle does photosynthesis occur? K/U
9. Through photosynthesis, plants are the ultimate food source for almost all terrestrial life on Earth. K/U A
- How is this process linked to maintaining Earth's climate conditions?
  - What human activities have the greatest impact on native plant populations and diversity?
  - Which human activities negatively affect the role of plants in maintaining Earth's climate? Explain your reasoning.
10. Earth's biomes have different climates, soils, and plant types. T/I
- Predict the adaptations you would expect to see in plants that grow in the following locations.
    - the Arctic
    - hot desert
    - tropical rainforest
  - Explain the predictions you made in (a).
11. A nursery worker reproduces many of her plants by rooting cuttings. What kind of reproduction is this? K/U

12. Plants undergo photosynthesis and cellular respiration. Both processes require that plant cells exchange gases with the atmosphere. What leaf structure is responsible for gas exchange in plants? K/U
13. Predict the adaptations of plants growing in a region of your own choosing. In your answer, describe the conditions to which the plant would be adapted. K/U A

## Skills Review

14. **Figure 3** is a photograph of parenchyma cells in the root of a buttercup.



**Figure 3** Light microscope image of a buttercup (*Ranunculus*) plant root ( $\times 80$ )

- Draw a labelled biological diagram of three adjacent parenchyma cells. K/U C
  - When this sample was prepared for viewing under the microscope, iodine stain was applied. Iodine stains starch. Based on this information, what is one function of the parenchyma cells in this root? K/U T/I A
  - What characteristic(s) of these cells allows you to identify them as plant cells rather than animal cells? K/U T/I
15. Create a graphic or written description of the steps in preparing a wet-mount slide for viewing under a microscope. T/I C A



## CAREER PATHWAYS PREVIEW

Throughout this unit you will see Career Links in the margins. These links mention careers that are relevant to plant anatomy, growth, and function. On the Chapter Summary page at the end of each chapter you will find a Career Pathways feature that shows you the educational requirements of the careers. There are also some career-related questions for you to research.